PHYTOTOXICOLOGY ASSESSMENT SURVEY INVESTIGATION IN THE VICINITY OF CANADIAN GENERAL-TOWER, CAMBRIDGE, 1989

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Phytotoxicology Assessment Survey Investigation in the Vicinity of Canadian General-Tower, Cambridge - 1989

Background

At the request of the Ministry's Cambridge office, the Phytotoxicology Section visited a woodlot immediately south of the Canadian General-Tower plant in Cambridge to investigate circumstances relating to the death of a large number of trees. The General-Tower plant produces PVC (polyvinyl chloride) sheet and the product is marketed in the form of films, sheeting and coated fabrics. In 1987, the plant produced approximately 50 million pounds of PVC sheet. The purpose of the Phytotoxicology investigation was to determine if PVC-related industrial emissions or other factors had caused the trees to die. The affected woodlot was adjacent to the south of Canadian General-Tower.

Phytotoxicology Investigation

On September 13, 1989 Mr. G. Vasiloff of the Phytotoxicology Section visited the area and conducted a comprehensive examination of vegetation west of the plant and in the affected woodlot area immediately south of the factory. An overview of the area is provided in Figure 1. Shown in the figure are the vegetation and soil examination and sample areas, the approximate location and size of the area of dead trees and other pertinent geographic structures.

Two features of considerable interest were noted to the south and southwest of the plant. Immediately to the south, a very low, wet area containing numerous declining and dead trees was observed (site 4). In this low area, a large number of pools containing standing water were present. The second feature - a large (1 metre diameter) concrete pipe outlet (site 13) - is the apparent source of the water found in the low area. A nearby resident advised that the pipe is connected to a part of the city's sanitary and storm system. As originally constructed, water which emerged from the pipe was intended to follow the course of an excavated drainage ditch which leads directly to the nearby Grand River. Although vestiges of the ditch were visible during the Phytotoxicology visit, it had generally become filled with sediment and other material over the years. As a result, water which now emanates from the storm system, overflows the ditch and floods into the adjacent low areas of the woodlot south of Canadian General-Tower.

Although the low area was extensive in size, dead and declining trees were only found in the areas which appeared to be chronically wet or flooded. Trees which are not suited to withstand the effects of continuous wet conditions appeared to be the first to die. Those less sensitive to periodic flooding were still alive, although most exhibited various symptoms of stress. None of the observed symptoms were characteristic of chemical injury. It was obvious that the crowns of all surviving trees had diminished in size, resulting in numerous dead twigs and branches. Remaining foliage was generally stunted and chlorotic in appearance.

Vegetation located on higher ground (site 3), south of the Tower plant and between the company fence and the low wet area, was examined and found to be free of injury symptoms characteristic of industrial pollution.

Soils in a low area southwest of the plant (site 8) were found to be dry, although it was evident that periodic flooding had taken place in the past. No dead or declining trees were observed in this location.

Vegetation located on higher ground west of the Tower plant (site 1) was examined and found to be normal and injury-free. Detailed visual observations of all vegetation examined during the survey visit are summarized in Table 1.

Based on the situation observed, it would appear that the decline and death of trees in the low wet area to the south of Canadian General-Towerwas due to root suffocation as a result of repreated flooding from the storm drain. Only trees located in the chronically wet soils in this area exhibited symptoms of crown dieback and stunted and chlorotic foliage.

An open ditch (site 14) was observed leading south from a buried culvert on company property to the main drainage ditch. Although the soil in the company ditch was dry, the position of debris along the edge indicated that a flow of liquid material had taken place. Downstream from the company ditch/main drainage ditch juncture, large amounts of straw were observed along the banks (site 10). No straw was observed upstream of the juncture. Since straw would not be indigenous to the area, its presence at that particular location was curious.

Because evidence indicated that a liquid flow had taken place in the company ditch, a single sample of soil (0-5 cm depth) was obtained from the company ditch (site 5) for organic analysis. Other single samples of soil were obtained from the main drainage channel but downstream from the company ditch (site 6), from the main channel (site 7) and from a dry site in a low area (site 8). The soil samples were submitted directly to the Ministry's Organics laboratory for tests to determine the presence and concentation of phthalate plasticizers - material which would be associated with a vinyl plastics operation.

Chemical Analysis Results - Soils

Tests dectected a concentration of 24,000 ppm of a phthalate plasticizer (C_8 and greater molecular weight alcohols) in the soil obtained from the drainage ditch at site 5. Soil downstream from the company ditch (site 6) contained 1,200 ppm of the same phthalate material. No trace of the material was found in the soil obtained near the storm drain (site 7) or in the control soil (site 8). Since the plasticizer material is directly related with vinyl products, it would be reasonable to conclude the source to be the Canadian General-Tower plant.

Given the high concentration of the phthalate found in the drainage ditch soil, injury to vegetation would have been severe had the plasticizer been phytotoxic. Further, injury and tree death would have been non-selective, relatively swift, and should have produced some chemical-type foliar injury symptoms. Since none of these conditions were observed, it can be concluded that the plasticizer was not phytotoxic and did not cause the death or decline of the trees in the woodlot.

Tree Increment Cores

In order to diffentiate the impact of the flooding and the plasticizer found in the soil on the woodlot trees, increment cores were obtained from two trees for annual ring analysis. Cores were obtained from severely stressed white ash (10 cm DBH - diameter at breast height - 1.3 metres) and poplar (35 cm DBH) trees growing in the low, wet area south of Canadian General-Tower and examined in the Phytotoxicology laboratory at Brampton.

Increment Core Analysis Results

Gradual decline of a tree by root suffocation (flooding) would typically be indicated by gradually reduced current annual ring growth preceded by a period of more vigouous growth. Conversely, decline and death by chemical toxicity would likely be indicated by a history of normal growth followed by a sudden decline or abrupt reduction in ring size.

Annual ring growth chronologies for the poplar and ash increment cores are illustrated in Figure 2. Measurement values for each of the cores are summarized in Table 2. The graphs show that the annual ring growth declined in both trees from the late 1970's through to and including 1989. Based on the growth patterns seen in the increment cores, both trees have been in decline for approximately ten years. The stress has been particularly acute for the last 6 years for the ash and about last 3 to 4 years for the poplar. The reduced annual ring growth observed in these two trees is consistent with what would be expected to occur as a result of severe stress such as water suffocation.

Conclusions

Based on the evidence gathered from the area, it was concluded that repeated flooding by water from the city storm drain caused the decline and death (by suffocation) of the trees located in the low area immediately south of the Canadian General-Tower plant. The slow and gradual decline of annual ring growth observed in several sample increment cores is consistent with effects caused by suffocation.

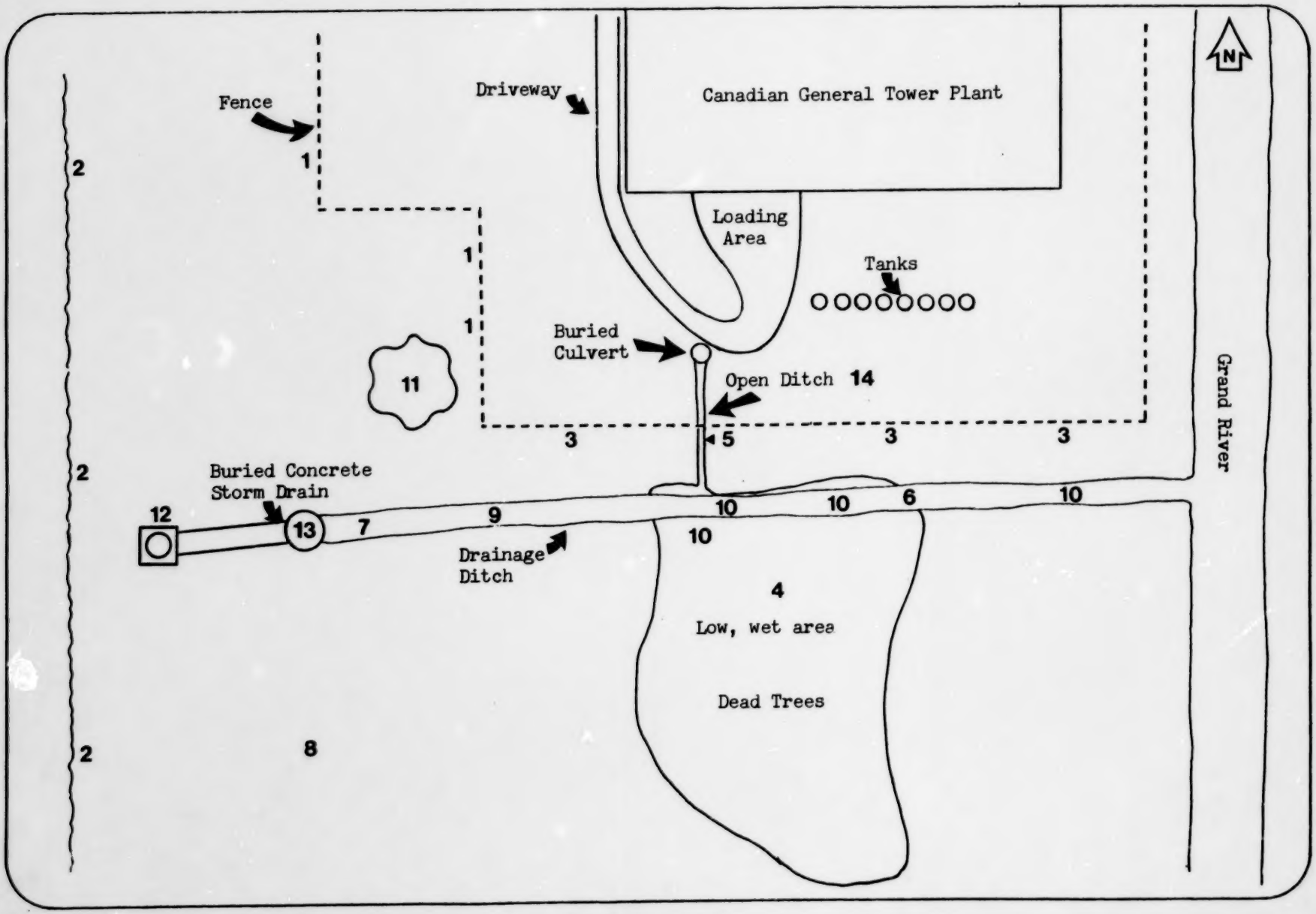
Further decline and death of woodlot trees could probably be avoided by dredging the main drainage ditch from the storm drain outlet to the river. This action would prevent overflow water from flooding the low areas within the woodlot.

Although test results indicated the presence of a very high phthalate plasticizer concentration in the company ditch soil, the absence of chemical-type foliar injury, the selectivity of tree effects and the annual ring evidence would suggest that the material was not the cause of the decline and death of the woodlot trees.

At this time, none of the evidence (absence of chemical injury symptomatology of the foliage and no sudden decline in annual ring growth) suggests that the decline and death of the trees in the woodlot could be attributed to air or liquid emissions from the General-Tower plant.

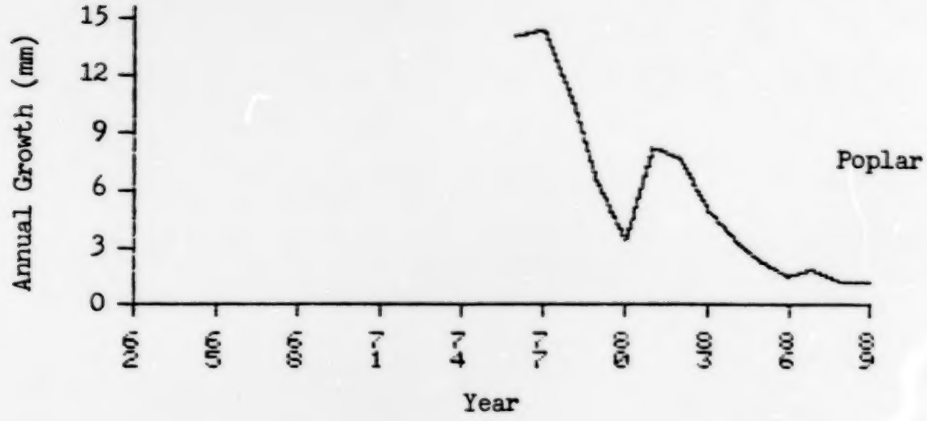
The presence of a very high concentration of a vinyl-related plasticizer in the company ditch was a clear indication that a flow of this material took place and that the source was likely the General-Tower plant. Since effluent released into the company ditch would eventually drain into the Grand River, immediate efforts should be made to eliminate further releases into the public waterway.

FIGURE: 1 Phytotoxicology Surveillance Areas in the Vicinity of Canadian General Tower, Cambridge



Sketch Not To Scale

FIGURE: 2 Plotted Annual Ring Growth of Ash and Poplar Trees in the Low Wet Area Near the Canadian General-Tower Plant



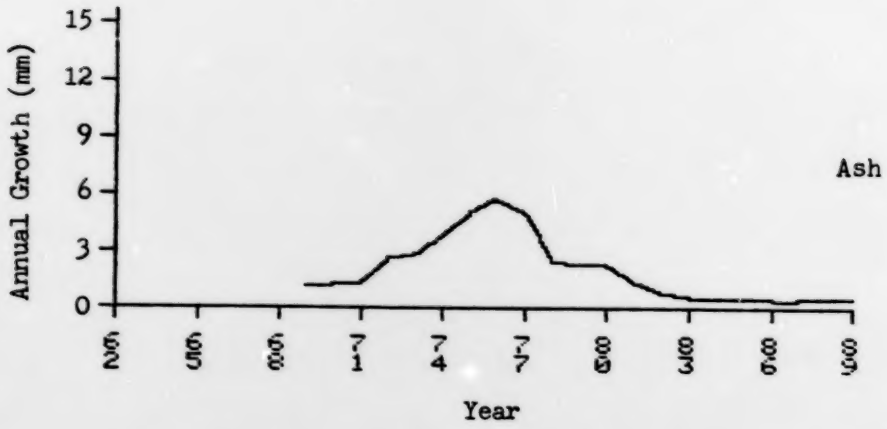


TABLE: 1 **Observational Notes of Vegetation and Structures Examined in the Vicinity of Canadian General-Tower, Cambridge**

Vegetation/ Structures Examined	Numerical Position in Fig. 1	Observations
	1	**Along fence line - west side of Tower property. Site high and dry.**
Manitoba maple	1	No visible pollution injury.
Sugar maple	1	No visible pollution injury.
Sumac	1	No visible pollution injury.
Black walnut	1	No visible pollution injury.
	2	**Rear of private properties - west of fenced Tower property.**
Green ash, trembling aspen, elm, black walnut	2	No visible pollution injury.
	3	**Along fence line - south end of Tower property. Site high and dry.**
Manitoba maple, dogwood, milkweed, wild grape, black walnut, golden rod, weeping willow, green ash, trembling aspen	3	No visible pollution injury.
Partial List	4	**Low, wet area containing dead trees. Evidence of recent flooding.**
Spruce	4	Dead.

TABLE: 1 (Cont'd)

Vegetation/ Structures Examined	Numerical Position in Fig. 1	Observations
Dogwood	4	Under stress - terminal & marginal foliar necrosis.
White ash	4	Crown 80% defoliated. (Increment core)
Black walnut	4	Crown 50% defoliated. Many dead branches in crown.
Spruce (22.5 cm DBH[1])	4	Dead
Spruce (20.0 cm)	4	Dead.
Wild cherry clump	4	Crown 90% defoliated.
Willow (25 cm)	4	Numerous dead branches in crown.
Cedars (2) (10.0 & 7.5 cm)	4	Dead.
White ash (5.0 cm)	4	No visible pollution injury.
Trembling aspen (4.0 cm)	4	2-10% terminal & marginal necrosis on 100% of all foliage.
Bullrushes	4	No visible pollution injury.
Grasses	4	No visible pollution injury.
Wild cherry (10.0 cm)	4	Boundary area between wet and dry areas. 98% of foliage recently died.
Poplar (35.0 cm)	4	Located below open company ditch. Crown 99% dead. (Increment core)
White birch	4	Numerous trees dead throughout low, wet area.

TABLE: 1 (Cont'd)

Vegetation/ Structures Examined	Numerical Position in Fig. 1	Observations
Soil (0-5 cm depth)	5	Soil sample - open company ditch immediately south of fence.
Soil (0-5 cm)	6	Soil sample - from drainage ditch - downstream from company ditch.
Soil (0-5 cm)	7	Soil sample - immediately downstream from storm drain outlet.
Soil (0-5 cm)	8	Control soil sample - 50 metres south of manhole (13) - low, dry area. Evidence of previous flooding.
Drainage ditch	9	Approximately 1 metre wide and 0.3 metres deep. Very clear standing water.
Straw	10	Straw observed from point where company ditch joins drainage ditch and in drainage ditch towards Grand River.
Flooded area	11	Low swampy area - remanants of dead trees observed.
Raised manhole	12	Connected by buried pipe to concrete drain outlet. fence where ditch

[1] DBH - diameter at breast height

TABLE: 2 Annual Ring Measurements of Cores Obtained from Trees Located in a Low, Wet Area Near the Canadian General-Tower Plant, Cambridge

Year	Annual Ring Width (mm)	
	Ash	Poplar
1989	.41	1.21
1988	.38	1.23
1987	.31	1.83
1986	.49	1.38
1985	.38	2.32
1984	.43	3.49
1983	.53	4.93
1982	.84	7.70
1981	1.35	8.17
1980	2.15	3.32
1979	2.19	6.61
1978	2.39	10.91
1977	4.96	14.29
1976	5.70	13.91
1975	4.98	
1974	3.75	
1973	2.71	
1972	2.48	
1971	1.16	
1970	1.12	
1969	1.09	